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Course:- Chemistry 102

Assignment

① Give the IUPAC names of the following compounds

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i) $HCOOH$ → Methanoic acid
ii) $HOOCCH_2CH_2CH_2COOH$ → Pentan-1,5-dioic acid
iii) $CH_3CH_2CH_2COOH$ → Butanoic acid
iv) HO_2C-CO_2H → Ethanedioic acid
v) $CH_3(CH_2)_4COOH$ → Hexanoic acid
vi) $CH_3CH=CHCH_2CH_2COOH$ → Hex-4-enoic acid

② Discuss briefly the physical properties of carboxylic acid under the following headings

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① Physical appearance:- All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature. Most are solid at room temperature although anhydrous carboxylic acid (Acetic acid) also known as glacial ethanoic acid freezes below the room temperature

ii) Boiling point:- It increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

iii) Solubility:- All carboxylic acids are soluble in organic solvents. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent

③ Write two industrial preparations of carboxylic acids

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① From petroleum:- Liquid phase air oxidation of C_5-C_7 alkanes, obtainable from petroleum at high temperature and pressure will give C_5-C_7 carboxylic acids with methanoic, propanoic and butanedioic acids as by-products.

ii) From ethanol:-

$$HC\equiv CH \xrightarrow{dil.\ H_2SO_4/HgSO_4} CH_3CHO \xrightarrow{O_2/(CH_3COO)_2Mn} CH_3COOH$$

④ With equations and brief explanation discuss the synthetic preparation of carboxylic acids.

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① Oxidation of primary alcohols and aldehydes:- Using the usual oxidizing agents in acidic solution

$$RCH_2OH \xrightarrow{[O],\ excess\ acid/KMnO_4} RCHO \xrightarrow{[O]} RCOOH$$

ii) Hydrolysis of nitriles (Cyanides) or esters:-

$$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_4^+$$

(where R = alkyl or aryl radical)

iii) Carbonation of Grignard reagent:-

$$RMgBr + CO_2(C_2H_5)_2O \rightarrow RCOOMgBr \xrightarrow{H_2O/dil.\ acid} RCOOH + MgBrOH$$

(where R may be 1°, 2°, 3° aliphatic alkyl or aryl radical)

⑤ With chemical equations only, outline the reduction, decarboxylation and esterification of carboxylic acids

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① Reduction:-

a) Lithium tetrahydridoaluminate (III) and diborane:-

$$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2LiAlO_2 + 4H_2$$

$$(RCH_2O)_4AlLi \xrightarrow{4H_2O} 4RCH_2OH + Al(OH)_3 + 4OH$$

ii) Decarboxylation:-

a) Thermal decarboxylation:-

$$CH_3CH_2CH_2COONa + NaOH \xrightarrow{fuse} CH_3CH_2CH_3 + Na_2CO_3$$

iii) Esterification

a) Presence of strong acid catalyst:-

$$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xleftrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$$